

A SYNTHESIS OF URBAN-SUSTAINABILITY FRAMEWORKS

An Undergraduate Research Scholars Thesis

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ABSTRACT

A Synthesis of Urban-Sustainability Frameworks

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There are far-reaching consequences of contemporary urbanization for sustainability and human well-being. Most of the world populations live in urban areas, with the most rapid growth in urban populations occurring in the medium-sized cities of developing countries. Urbanization causes changes in land use and land cover across local, regional and global scales, which have an immense range of consequences. The interconnected social, economic, and ecological components of contemporary urbanization need to be studied in order to prevent loss of ecosystem services and encourage future environmental, economic, and social wellbeing. These changes in land use, increasing population, and income levels are becoming increasingly important as the environment, economies, and social aspects of cities are changing with the growth. In this research, I will synthesize theoretical and conceptual frameworks for moving towards urban sustainability. To this end, I will study the urbanization literature, specifically papers that discuss different aspects of the issue and possible solutions. The terminology used to describe urbanization, the field of study from which the authors originate, the country affiliation, and the main components of their theoretical or conceptual points of reference; including any suggested solutions to problems of urbanization are the areas of interest for this research.

CHAPTER I

INTRODUCTION

Contemporary urbanization is playing an increasingly important role in environmental change across multiple spatial and temporal scales. Already more than 50% of the world population is living in urban areas; this is projected to increase to almost 70% by 2050 (UN 2014). Around 80% of global GDP is generated in urban areas (GEA 2012). Moreover, by 2030, urban land cover is forecasted to increase almost three times of its extent in 2000 (Seto, Güneralp et al. 2012). Urbanization can change hydrological and biogeochemical systems, alter air quality, and cause loss and fragmentation of habitats (Grimm, Faeth et al. 2008). Growing urban areas also influence their own exposure and vulnerability to various natural hazards. Nevertheless, the concentration of people, resources, and economic activity in cities also presents opportunities for moving towards sustainability. The research of ecosystems is becoming more interdisciplinary and the research should focus on a wide range of urban areas in the world, different scales, and in various economic, ecological, and social contexts in order to get a full picture of the future trajectories of ecosystem services in relation to urbanization (Haase 2014).

Impacts of urban expansion on biodiversity and ecosystem services will likely be significant (Güneralp and Seto 2013). Impacts on biodiversity include habitat loss, fragmentation and degradation of remaining blocks of natural habitats, the increase in non-native species, and the loss of sensitive indigenous species. Habitat loss and alteration due to urbanization are often irreversible (McKinney 2002). The development of urban settlements increases local extinction rates and eliminates many local species. Considering the value of natural capital, urban

governance and planning has the potential to mitigate a large amount of loss of biodiversity (McDonald, Güneralp et al. 2014). In addition, urban development and biodiversity conservation strategies need to be synthesized because they will also have impacts on food and food security (Güneralp et al 2013).

Where urbanization takes place also significantly affect the number of people and infrastructure exposed to natural hazards (Güneralp, Güneralp et al. 2015). In particular, floods and droughts are among the most frequent, dangerous, and costly of all natural disasters, causing significant damage to infrastructure and affecting the livelihoods of millions every year.

Urban areas are also characterized by patterns of social differentiation. Differentiation in relation to urban ecology deals with the allocation of crucial resources, and who gets what according to their class, age, gender, and other social identities (Pickett, Cadenasso et al. 2011). It is important for research to address the ecological facts, as well as the social factors that contribute to differences in urbanization (Hetrick, Roy Chowdhury et al. 2013). In a study done by Hope, Gries et al, plant diversity across the urban landscape was positively related to income in the surrounding area. Moreover, the relationship between wealth and plant diversity appears to translate to other urban landscapes than the study area (Hope, Gries et al. 2003). The social factors are important due to the association of income and environmental features and access to these environmental resources (Benítez, Pérez-Vázquez et al. 2012).

There exists the capacity to guide processes of governance in urban planning, yet a number of underlying challenges remain: coordination between planning departments, integration of new

policy into established adaptable policy cycles and assessing the lessons from current green initiatives (Haase 2014). Policies that would be able to change the current urbanization trends would have to target the cause of land-use change and how ecosystem services are being treated in policy making (Lawler, Lewis et al. 2014). Research on different cities are finding better ways to see success in implementing policies and determining the success of city's planning for future mitigation (Rosenzweig, Solecki et al. 2010). Wheeler states that sustainable urban form is likely to be compact, contiguous, connected, diverse and ecological (Wheeler 2003). Creating a synergy between sectors of science and policy making is crucial for creating sustainable cities and urban forms as cities are interconnected (Wheeler 2003, Rosenzweig, Solecki et al. 2010).

Through critically analyzing current literature on sustainability and urbanization, this research aims to reach a synthesis of theoretical and conceptual frameworks for moving towards urban sustainability. The specific research questions that I will address will be: From what fields of study does each of these theories and conceptualizations originate? Do the disciplinary affiliations or geographic origins of the authors seem to affect their approach to sustainability research? What can these disparate theories/frameworks learn from each other? If current ideas about sustainability in cities are analyzed across multiple fields then common goals can be achieved from the synthesis of research. Reaching such a synthesis would encourage collaboration between the academic community and practitioners to formulate effective policies to reduce the negative impacts of urbanization.

CHAPTER II

METHODS

I have selected literature that focuses on the issue of sustainability in urbanizing areas, especially papers that offer a solution for becoming a more sustainable community. To this end, I performed a literature search using the Scopus databases. First, I examined the abstracts of the papers identified during the literature search to determine if the paper's focus is on urbanization and sustainability, as well as if they offer a solution. Next, I critically reviewed each paper to determine the drivers and impacts of urbanization considered, the methods they used, its relation to the field of study from which the research originated, and most importantly how they defined sustainability and what solutions they formulated. I examined the terminology used to describe sustainability issues in each study to determine the most common terms used in the literature. This examination revealed connections among social, economic, and environmental issues being considered in these papers in the context of urban sustainability.

The literature came from multiple disciplines, yet they had common goals of improving the sustainability of urbanizing cities. The literature had common goals; I have compared the solutions offered and came up with a comparison of the concepts. The resulting comparison showed different perspectives on the drivers and impacts of urbanization and different solutions for sustainability in different fields such as engineering, ecology, and geography.

In order to determine the similarities and differences in concepts, it was crucial to review each chosen paper to determine the main concepts offered as solutions for achieving urban

sustainability. I compared the frameworks critically in terms of the type of solutions offered in each framework, and how these solutions shaped by the characteristics of each discipline that the frameworks originated from. I determined that I would be able to divide the frameworks into groups to see what solutions are commonly offered by what disciplines and if they overlap or are distinctly different in other disciplines of research.

CHAPTER III

RESULTS

When comparing approximately 20 urban-sustainability frameworks from different disciplines, some overlapping features, and differing concepts were identified. I determined the frameworks fell into 3 main categories. One of these categories discussed solutions from the standpoint of conserving biodiversity and ecosystem services, as well as finding a way to determine a net benefit for the environment and society. Another identified group of frameworks studied urban sustainability more from the perspective of creating healthy and livable cities, consideration of human welfare as it relates to the environment, and creating a sense of place. The third group contains frameworks developed to look into multiple system interactions, linkages, complete lifecycles of products, and finding synergies.

Since many of the frameworks utilized overlapping ideas, it made finding distinct categories for the frameworks difficult, so it seemed more useful to present these groups as fluid and overlapping. Categorizing the urban sustainability frameworks was helpful in determining the differences, but also in seeing the similarities between most of the frameworks chosen as some used some concepts from multiple groups.

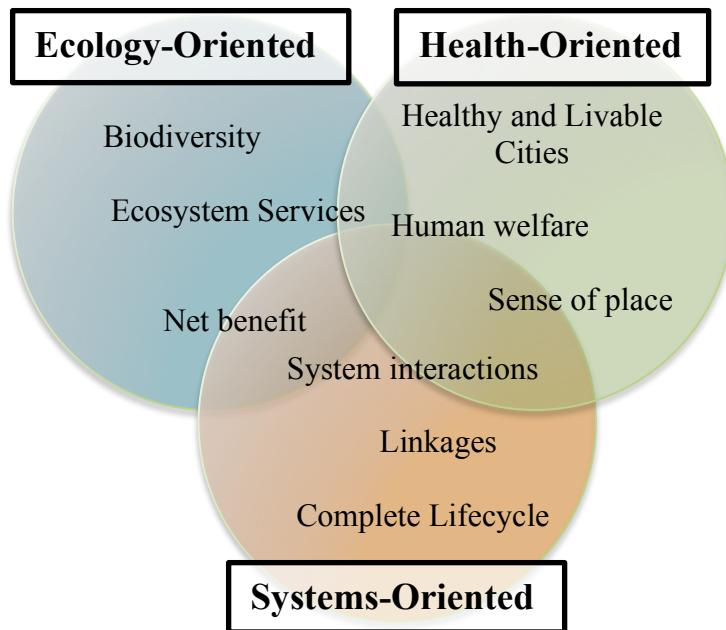


Figure 1. Three Framework Themes. The three main themes found in the frameworks are shown above conceptually showing their differences, but also overlapping due to some similarities.

I found that in summarizing many complex frameworks offered by authors from multiple disciplines, most of the ideas described were related to the concepts seen in Figure 1. When first reading the frameworks, they seem vastly different in offering different perspectives on urban-sustainability solutions, but in further analysis they had more in common than expected. Many of them used the same concepts as offered solutions for urban sustainability, for example, many believed that incorporating ecosystem services in some way would improve sustainability in the cities. Although there were clear similarities in each group of frameworks in Figure 1, many authors offered unique ideas for urban sustainability that cannot completely be expressed by the concepts in the figure.

Environmental sciences, ecology, environmental studies, geography and urban studies were most frequently used subject categories and Landscape and Urban Planning was the most productive

journal in urbanization studies (Wang, He et al. 2012). Marcotullio and McGranahan suggest that global initiatives are the most obvious solutions to environmental sustainability, yet local governance is relied on heavily due to the complex nature of global policy. They describe that water, sanitation, and hygiene deficiencies are at the center of the environmental health problems experienced by deprived urban communities. They say re-scaling the politics is as important as re-scaling the environmental burdens themselves. Since the environmental issues are becoming dispersed, and economies are very much reliant on local labor and production, current governmental practices have shifted to more direct and locally focused economic development policies. Without some form of governance structure local policy makers have no economic incentive to act. (Marcotullio and McGranahan 2012). Although there have been studies that examined urbanization and sustainability on the global scale, much of the work done by researchers so far came up with sustainability frameworks and practices that would only create local sustainable improvements.

When specifically considering sustainable development in urban planning, Berke's article defined six principles of sustainable development in regards to urban planning: harmony with nature, livable built environments, place-based economy, equity, polluter's pay, and responsible regionalism (Berke 2008). He then evaluated 30 comprehensive city plans to see if their policies appear to support these principles in their implementation. He discovered that most plans focus on a few of the principles, if any, and do not equally integrate all of the ideas of sustainable development (Berke 2008). In another one of Berke's paper he argues that most of the visionary environmental ideas have not been implemented in urban planning, despite the growing demands for sustainable communities and scientific support for the positive effects green communities

have on sustainability. He recommends that research needs to focus on mobilizing collaborative planning, incentives that encourage greener communities, and new assessment tools for green building and monitoring. These ideas were important to consider while studying these sustainable frameworks to determine if they would be successful for planners to implement (Berke and Conroy 2000).

While studying the various frameworks some of the main ideas that were suggested had a theme of how to incorporate ecology into cities. Graedel proposed an urban sustainability framework that describes the entire city as the sum of its parts, a living changing being, and a metabolism of its inhabitants, in an “Ecocity” (Graedel 1999). If the city’s metabolic flows are studied- nutrients, energy, storage, residue, from an ecosystem perspective the environmental impacts of the residues of the cities can be studied. If a city was made environmentally superior it is referred to as what might be an “Ecocity”. The inhabitants, location, and surrounding environment would affect that urban “organism”. In order to be a successful “ecocity” the city must: be sustainable over the long term, utilize a systems approach to evaluating its environmental interactions, the design must be flexible enough to evolve gracefully as the city grows and changes, the open space must serve multiple functions, must be a part of regional and global economies, and attractive and workable (Graedel 1999).

Seto, Fragkias et al. suggest that urbanization presents opportunities for efficient resource use and mitigating climate change (Seto, Fragkias et al. 2011). Compact urban development coupled with high residential and employment densities can reduce energy consumption, vehicle miles traveled, and carbon dioxide emissions. Increasing urban albedo could offset greenhouse gas

emissions. Furthermore, per capita greenhouse emissions of urban areas are often lower than national averages”(Seto, Fragkias et al. 2011). and as Owen points out densely populated cities are environmentally sustainable due to their lower consumption of fossil fuels, which is important for future generations striving for a higher environmental performance (Owen 2004). It is also important that education and integration of biodiversity occurs within cities as management will only be successful with the support of land stakeholders (Turner 2004). Another tool is the sustainability assessment; Newman believes this does a good job of approaching future issues by producing a scenario where there is a ‘net benefit’ in the areas of environment, social and economic performance. To clarify, this means that in calculating the benefits there should not be any trade-off between the three areas. The main benefit to this method is that it does not focus simply on the negative realities of the way we are managing ecosystems today it gives us an idea of what needs to be done to promote a more positive outcome (Newman 2006).

The challenges of global land use requires the assessment and management of trade offs of meeting current human needs and sustaining the ecosystem’s ability to provide future goods and services. When analyzing the assessments of the various trade offs involved it is important to include information about the land providing people with crucial social and economic benefits, even though those benefits seem to be causing long-term externalities for human welfare as they alter ecosystems (Foley, DeFries et al. 2005).

Another framework discussed, presented by Niemela describes steps that would help urban planning researchers when looking at ecology. The first step is to find out what kind of nature

exists in cities. Second, is to become knowledgeable about ecological processes in cities. Third, based on ecological knowledge, management should maintain the diversity of urban nature. Finally, interdisciplinary research involving natural and social sciences is imperative for a holistic approach to integrating ecology into the process of urban planning (Niemela 1999).

Wheeler's article also proposes a framework for thinking about sustainable development in the cities. The article suggests a regional context and a long-term strategic approach in which vision statements, coalition building, institutional development, intergovernmental incentive frameworks, indicators, public involvement, and social learning help sustainable development become increasingly possible (Wheeler 2000).

One way that the current and future research can encourage successful land-use changes and ecosystems is by developing and implementing regional land-use strategies that recognize both short and long-term needs, balancing ecosystem services, and increasing the resilience of managed landscapes, but it will require much more cross-disciplinary research since ecosystems are complex and significantly impacted by humans (Foley, DeFries et al. 2005). Since an ecosystem's economic values are not accurately displayed from their commercial value, policy makers often do not consider them in policy making. Some examples of ecosystem services are gas and climate regulation, water supply, waste treatment, pollination, food production, and recreation. Since human capital requires natural capital it is not helpful to place a value on this human welfare simply would not exist without natural capital (Costanza, d'Arge et al. 1998). Results from another study show the existence of environmental injustice in the developing world due to the differences in availability of provisions and ecosystem services in the global

south and how it leaves them vulnerable to cultural and social strife. It shows a synergy between recreation potential and carbon storage across all cities. This would indicate that the more recreational opportunities such as parks, the more green spaces would be provided, which increases the carbon storage. The research shows how the combination of environmental conditions, socioeconomics, demographics and politics determines the provision of ecosystem services (Dobbs, Nitschke et al. 2014).

The current method of studying urbanization is an oversimplified examination of the driving growth factors of cities and it has a lack of a temporal approach. Using a temporal perspective would highlight the importance of land-use changes over time and the response of biodiversity to environmental change. The essential elements of a framework for contemporary urban ecology incorporate the characteristics of a growing understanding of urbanization (Ramalho and Hobbs 2012). An apparent outcome of land-use change is homogenization across urban areas, where neighborhoods in different parts of the country have similar patterns of roads, residential lots, commercial areas, and green areas. Understanding urban homogenization, the idea that these patterns exist, will provide the basis for understanding the impacts of urban land-use change from local to global scales. The finding from this research is that lifestyle factors such as family size, life stage, and ethnicity, are weakly correlated with socioeconomic status and play a crucial role in determining property management in various neighborhoods. The homogenization strongly influences not only environmental change at global scales but also the quality of life for most of the world's human population (Groffman, Cavender-Bares et al. 2014).

Fundamentally, giving value to ecosystem services and biodiversity in the marketplace, and considering their values in governance and urban policies could mitigate a large amount of loss of biodiversity. Another direct solution would be to set aside/preserve lands which are known bio diverse hotspots to protect them from the effects of urbanization and reduce the loss of native species. However, many biodiversity hotspots threatened by urban growth are located in developing countries, which may have limited financial resources to devote to land protection (McDonald, Guneralp et al. 2014).

The literature review showed that the various authors provided a unique perspective on the solutions to urban sustainability. Although these differences and details provided by different authors are crucial to finding new perspectives on urban sustainability, I wanted to focus more on their similarities due to the overall goal of collaboration between researchers. In Table 1, I have an example of 6 of the frameworks studied on how I compared their main ideas to create Figure 1 and the three framework groups. While analyzing, I did this to compare all of the frameworks in multiple large tables. The first two frameworks in the table were examples from the Ecology-Oriented group, the second two were from the Health-Oriented group, and the final two were from the Systems-Oriented group. In these examples, these frameworks did not all distinctly have concepts from only those groups. Many had overlapping concepts from other groups, so I loosely put them in these groups, and just acknowledged that there were some concepts from the other groups present. For example, I determined what the focus of the paper was, if it discussed human welfare at length, but mentioned ecosystem services as a method of achieving human welfare, then I put it in the Health-Oriented group due to its overarching focus on human welfare.

CHAPTER IV

DISCUSSION

The literature review of the frameworks proved to be useful in determining the similarities and differences of urban-sustainability frameworks being offered by scholars from different disciplinary backgrounds. Urban sustainability would benefit from collaboration between disciplines and acquiring a general knowledge of the ideas presented by other fields. This framework comparison was to show although many disciplines have different perspectives on urban sustainability; most have some common goals of improving sustainability in cities globally. The different ideas and experiences of authors in the field of urban sustainability could be utilized in a collaboration of efforts to create a few major frameworks utilizing the strengths from all the concepts discussed in this paper. If an urban sustainability framework could be created combining the ideas from all these frameworks and disciplines with a focus on tangible and specific ideas for city planners to implement, such as the idea of ecosystem services or creating healthy and livable cities, we might see more meaningful progress towards sustainability in the world's cities.

These concepts discovered through this literature review are just a few of the many proposed solutions for urban sustainability. The main hope of this paper is to encourage future discussion between academics in how to transform these complex ideas into more tangible, concise, and cross-disciplinary ideas for policy makers and urban planners with the hope for implementing true change. In some cases, it is discussed that there is some hesitation to implement large-scale sustainability ideas because not many cities want to be the first to implement an untested idea at

such a large scale and it can cause economic stress on cities if these sustainability plans do not succeed. If the ideas are first implemented in small-scales where failure is not economically or socially detrimental then maybe we will see less hesitation on the part of urban planners to test the concepts discussed in academic research in real-life settings.

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APPENDIX

Table 1. Summaries Representative Frameworks.

Framework first author	Affiliation	Main ideas	Overlapping aspects
McDonald	Ecology	<ul style="list-style-type: none"> • Ecosystem services viewed similarly to a utility. • Expanding urban areas, which are becoming close to vulnerable regions of biodiversity, can be leaders in biodiversity at the global level. • Coordination by governments at all levels is important to the sustaining of biodiversity and ecosystem services. 	<ul style="list-style-type: none"> • Potential in cities to lead the way in sustainability • Ecosystem Services • Biodiversity
Turner	Ecology	<ul style="list-style-type: none"> • Both ecological and socioeconomic factors are involved in the biodiversity outcomes from urbanization. • There are two options: Either move humans to nature, or bring nature to humans. • It is also important that education and integration of biodiversity occurs within cities. 	<ul style="list-style-type: none"> • Ecosystem • Economics, • Social Factors • Biodiversity
Newman	Sustainability	<ul style="list-style-type: none"> • The sustainability assessment is good for approaching future issues. • It produces a 'net benefit' in the areas of environment, social and economic performance. • This means that there should not be any trade-off between them • Focus on how to promote positive outcomes. 	<ul style="list-style-type: none"> • Human health • Socio-economic importance • Net benefit • Sustainability assessment

Table 1. Continued.

Framework first author	Affiliation	Main ideas	Overlapping aspects
Pickett	Ecosystem studies	<ul style="list-style-type: none"> • Proposes a humane metropolis, summarized as: • Protecting and restoring ecological services in cities • Promoting physical and mental health and safety of residents • Conserving energy, matter, water, and time • Facilitates being inclusive, as well as socially and environmentally just • Maintaining a sense of community/place 	<ul style="list-style-type: none"> • Promoting both environmental and human health in cities • Humane metropolis
Guneralp	Geography	<ul style="list-style-type: none"> • Focus on linkages between processes and places. • Using: willingness to pay for ecosystem services in distant locations, to physical movement of materials, people, and money between urban and nonurban places 	<ul style="list-style-type: none"> • Linkages between urban and non urban places • ULT • Ecosystem Services
Graedel	Industrial ecology	<ul style="list-style-type: none"> • Goal is to be sustainable over the long term by utilizing a systems approach to evaluating environmental interactions • Cities are constantly growing and changing, • Open space must serve multiple functions, must be a part of regional and global economies, and attractive and workable 	<ul style="list-style-type: none"> • City as a living changing organism: Ecocity • Systems/interactions